

ARGUMENTS/REMARKS

STATUS OF CLAIMS

Claims 1 – 19 are pending.

Claims 1 – 2 are withdrawn from consideration.

Claims 3 – 19 stand rejected.

No claims have been amended

Rejection of claims 3-19 under 35 U.S.C. 103(a) as being unpatentable over Song (US 2002/0177261 A1) in view of Kim et al. (U.S. Patent No. 6,593,603)

Claims 3-19 stand rejected under 35 U.S.C. 103.

As to claim 3, the rejection is respectfully traversed, for at least the reasons that (1) the references cited by the Examiner, even when combined, do not teach an integrated circuit having all of the limitations of claim 3; (2) the motivation asserted by the Examiner would not cause one of ordinary skill in the art to modify the principal reference as proposed by the Examiner; and (3) the modifications proposed by the Examiner would render the principal reference inoperative.

The Examiner states, on page 2 of the Office Action, that Song discloses a first block comprising an enhancement mode, a second block comprising a depletion mode pHEMT transistor on the substrate, the second block operatively connected to the first block, referring to Paragraphs [0024] to [0031], and Figure 4.

The Examiner concedes that Song lacks a third block comprising a power pHEMT transistor on the substrate, the third block operatively connected to at least one of the first block and the second block. The Examiner states that Kim discloses a high electron mobility transistor with a third block comprising a power

pHEMT transistor on the substrate, the third block operatively connected to at least one of the first block and the second block.

The standard for a *prima facie* case of obviousness is the following:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. . . . *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

MPEP §2142 (8th edition, rev. 2, 2004). "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). MPEP 2143.03 (8th edition, rev. 2, 2004).

The references relied on by the Examiner do not teach, even when combined, an integrated circuit having all of the limitations of claim 3. Song fails to teach the limitations of a "first block," a "second block" and the second block and the first block being operatively interconnected, as recited in claim 3. While Song teaches a particular substrate structure, an enhancement mode pHEMT transistor formed on the substrate, and a depletion mode pHEMT transistor formed on the substrate, there is no teaching of first and second blocks, nor of operative interconnections between blocks.

While Kim teaches a power pHEMT transistor, Kim does not teach a power pHEMT transistor on a substrate that also has an enhancement mode pHEMT transistor and a depletion mode pHEMT transistor formed thereon. The Examiner states that Kim teaches "a third block comprising a power pHEMT transistor on the

substrate, the third block operatively connected to at least one of the first block and the second block” citing col. 2, lines 7-45, and Fig. 1. However, the cited portions of the specification and Fig. 1 merely show a power pHEMT transistor. Contrary to the Examiner's statement, there is no block in Kim, and no disclosure of the limitation “operatively connected to at least one of the first block and the second block.”

The motivations asserted by the Examiner would not motivate one of ordinary skill in the art to modify the principal reference, Song, in the manner proposed. The Examiner states that “it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Song’s device (accordance with the teaching of Kim) to form a transistor since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art.” This statement is nothing more than an improper statement that the modification is within the capability of one of ordinary skill in the art.

A statement that modifications of the prior art to meet the claimed invention would have been “well within the ordinary skill of the art at the time the claimed invention was made” because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

MPEP 2143.01(IV). Indeed, the case relied upon by the Examiner, *St. Regis Paper Co. v. Bemis Co.*, 549 F.2d 843, 193 U.S.P.Q. 8 (7th Cir. 1977), *cert. denied*, 434 U.S. 833, 98 S. Ct. 119, 54 L. Ed. 2d 94 (1977), as a Seventh Circuit case, is not binding precedent in the Office, and furthermore, is not good law. The *St. Regis Paper Co.* opinion relies on the discredited “synergistic combination” standard,

stating: “the Lokey bag is only entitled to a patent if the fusion of the old elements that comprised the Poppe patent and the old element of multiple layering created a synergistic combination.” 549 F.2d at 838. The use of the “synergistic combination” standard has never been approved by the Federal Circuit, and indeed, was rejected by the Seventh Circuit a mere two years after *St. Regis Paper Co. in Republic Industries, Inc. v. Schlage Lock Co.*, 592 F.2d 963, 971 (7th Cir. 1979) (“Because synergism centers exclusively on the performance of the elements after combination and without regard to the obviousness or nonobviousness of making the combination, synergism does not comport with the Graham mandate to apply section 103.”) Accordingly, the Examiner’s reliance on *St. Regis Paper Co. v. Bemis Co.* is improper.

Moreover, the Examiner’s proposed modification to Song is without basis in fact or logic. Song already discloses two different types of transistors formed on a substrate. Thus, there is no need to modify Song to form a transistor. Furthermore, there is no duplication of components between Song and Kim, as Song teaches a depletion mode pHEMT and a conventional enhancement mode pHEMT on a substrate, while Kim teaches a power pHEMT on a different substrate.

The Examiner further states that “doing so would facilitate the manufacture of the semiconductor device and improve the speed of the semiconductor transistor.” However, since the Examiner has not explained how to combine Kim and Song, there is no indication of how to manufacture the claimed device. Moreover, the Examiner does not explain how the speed of the semiconductor transistor would be improved. Even if Song and Kim taught how to form the

various types of transistors on a single substrate, merely doing so would not improve the speed of the individual transistors.

Furthermore, the proposed modification to Song would render Song inoperative. "If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification." MPEP Section 2143.01 (V). A modification that renders a reference inoperative is not a proper ground for a rejection on the grounds of obviousness. Song and Kim cannot be combined, because the substrate of Kim and the substrate of Song are different. In particular, the substrate of Song has:

the semi-insulating substrate 120, the buffer layer 130, the channel layer 140, the spacer layer 145, the first barrier layer 150, the second barrier layer 152, the third barrier layer 154, and the ohmic layer 160. The buffer layer 130, the channel layer 140, the spacer layer 145, the first barrier layer 150, the second barrier layer 152, the third barrier layer 154, and the ohmic layer 160 are grown on the semi-insulating substrate 120 in sequence.

(Paragraph [0036]; Fig. 6A) These layers are explained in more detail as follows:

on a GaAs semi-insulating substrate 120 a buffer layer 130 that is composed of either an undoped GaAs, or a $\text{GaAs}/\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0 < x \leq 1$) superlattice, or a combination of undoped GaAs and $\text{GaAs}/\text{Al}_x\text{Ga}_{1-x}\text{As}$ ($0 < x \leq 1$) superlattice is formed. On the buffer layer 130 a channel layer 140 that is composed of undoped GaAs in the case of an HEMT device or undoped $\text{In}_x\text{Ga}_{1-x}\text{As}$ ($0 < x \leq 1$) in the case of a p-HEMT device is formed.

[0026] On the channel layer 140 a spacer layer 145 that is composed of $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ is formed. The spacer layer 145 prevents the decrease in electron mobility in the channel layer 140 due to scattering of electron by ionized impurities existing in the first barrier layer 150.

[0027] On the spacer layer 145 a first barrier layer 150, a second barrier layer 152, and a third barrier layer 154 in the order named are formed. Both of the first and third barrier layers 150 and 154 are made of $\text{In}_{0.5}\text{Ga}_{0.5}\text{P}$ that is lattice-matched to GaAs. In general, the barrier layers are n-type modulation doped,

and doping profiles thereof can be different according to their structures, e.g. uniform doping structure, delta doping structure, a mixture of the uniform and delta doping structures and the like. The second barrier layer 152 is made of $\text{In}_x\text{Ga}_{1-x}\text{P}$ ($0 < x < 0.5$) that is not lattice-matched to GaAs. The second barrier layer 152 is a strained layer, and should be formed thinner than a critical thickness that can be formed without generation of strain-induced dislocations. The critical thickness which can be formed without generation of strain-induced dislocations becomes thinner as the value x in $\text{In}_x\text{Ga}_{1-x}\text{P}$ decreases from 0.5, but is thicker than 2 to 3 nm if the value x is about 0.8.

[0028] On the third barrier layer 154 a heavily n-type doped GaAs ohmic layer 160 for forming drain and source ohmic contacts of the (p-)HEMT is formed.

The substrate of Kim has:

a GaAs buffer layer 12, an AlGaAs/GaAs superlattice layer 14, an undoped AlGaAs layer 16 having a large bandgap, a first doped silicon layer 20, a first spacer 22, a InGaAs electron transit layer 24 having a narrow bandgap, a second spacer 26, a second doped silicon layer 28 with a different doping concentration from the first doped silicon layer 20, a lightly doped AlGaAs layer 30, and an undoped GaAs cap layer 32 sequentially stacked on a semi-insulating GaAs substrate 10.

(col. 3, lines 49-61; Fig. 2).

For example, there is no equivalent in Kim of the three InGaP barrier layers of Song. The Examiner has not explained how to modify the substrate of Song to obtain the substrate of Kim, without rendering the devices fabricated on the substrate of Song inoperable.

In short, the Examiner has failed to provide a proper prima facie case of obviousness as to claim 3.

For the foregoing reasons, claim 3 is allowable over the prior art of record.

Claim 4 depends from claim 3 and recites, inter alia, a clock input, an analog input, and a digital input, wherein the first and second block connect to form an analog

to digital converter. The Examiner points out Paragraphs [0024] to [0031] and Fig. 4 of Song as disclosing these limitations (Office Action, page 3). There is simply no discussion at all of a clock input, an analog input, a digital input, or an analog to digital converter in the cited portion of Song. Kim does not teach these limitations either. Accordingly, the references as combined fail to teach all of the limitations of claim 4.

For this reason, as well as the reasons set forth above in connection with claim 3, claim 4 is allowable over the prior art of record.

Claim 5 depends from claim 3, and adds the further limitation that the integrated circuit is a microwave and millimeter wave integrated circuit (MMIC). The Office Action indicates, on page 3, that Song teaches the limitations of claim 5 at Paragraph [0003]. However, Song merely discusses the fact that depletion mode transistors can be used in fabrication of MMIC's, but does not discuss the use of enhancement mode transistors in MMIC's, and certainly does not disclose an MMIC having both an enhancement mode HEMT and a depletion mode HEMT. Kim also fails to teach these limitations. Accordingly, the references as combined fail to teach all of the limitations of claim 5. For at least this reason, as well as the reasons set forth above in connection with claim 3, claim 5 is allowable.

Claim 6 depends from claim 3, and adds the further limitation that the integrated circuit is capable of operating at a frequency within the range of from very low frequency up to and including X-band frequencies. In order for this limitation to be taught in the prior art, a reference must teach a circuit capable of operating at this entire frequency range; a circuit capable of operating at only a portion of this range does not teach the

limitations of claim 6. Song merely teaches a substrate and two transistors thereon; Song does not teach a circuit, and merely states, in Paragraph [0002] cited by the Examiner, that the HEMT can be used in applications operating in the frequency range between 10 GHz and 100GHz. Accordingly, the references as combined fail to teach all of the limitations of claim 6. For at least this reason, as well as the reasons set forth above in connection with claim 3, claim 6 is allowable.

Claim 7 is an independent claim reciting an analog to digital converter, having an enhancement mode pHEMT device, a depletion mode pHEMT device, and a power pHEMT device on a single substrate. The Examiner has failed to provide a proper prima facie case of obviousness as to claim 7, for the same reasons as set forth above in connection with claim 3. As to the failure of the cited references, even when combined, to teach all of the limitations of claim 7, neither of the references teaches an analog-to-digital converter. The Examiner points to col. 1, lines 15-35, and Fig. 1 of Kim as teaching an analog to digital converter comprising an enhancement mode pHEMT device and a depletion mode pHEMT device on a single substrate (Office Action, page 4). However, Kim nowhere teaches an analog to digital converter, and teaches only one type of device, namely a power pHEMT, on a substrate. For at least this reason, the cited references as combined fail to teach all of the limitations of claim 7.

For the reasons explained above in connection with claim 3, the motivation asserted by the Examiner would not cause one of ordinary skill in the art to modify the principal reference as proposed by the Examiner; and the modifications proposed by the

Examiner would render the principal reference inoperative. For at least these reasons, claim 7 is allowable.

Claims 8 and 9 depend from claim 7, and are allowable for the reasons that claim 7 is allowable.

Claim 10 is an independent claim that includes all of the limitations of claim 3, and is allowable for the reasons that claim 3 is allowable.

Claims 11 – 15 and 17 - 19 depend directly or indirectly from claim 3, and are allowable over the prior art of record at least for the reasons set forth above in connection with claim 3.


Claim 16 depends indirectly from claim 3, and further recites that the recess of the power pHEMT transistor is a double recess, the recess of the depletion mode pHEMT transistor is a single recess, and each of said recesses is defined through at least one common layer of said substrate. There is no teaching or suggestion in either Kim or Song of a power pHEMT transistor having a double recess and a depletion mode pHEMT transistor having a single recess, each of those recesses defined through at least one common layer of a substrate. Accordingly, the references as combined fail to teach all of the limitations of claim 16. For these reasons, as well as the reasons set forth above in connection with claim 3, claim 16 is allowable.

CONCLUSION

Wherefore, Applicant believes he has addressed all outstanding matters, and respectfully requests that claims 3 – 19 be allowed.

Should there be any questions or outstanding matters, the Examiner is cordially invited and requested to contact Applicant's undersigned attorney at his number listed below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Edward J. Howard', written over a horizontal line.

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